REMARKS

This reply encompasses a bona fide attempt to overcome the objections and rejections raised by the Examiner and the reasons why the Applicant believes the objections and rejections should be withdrawn.

1. Information Disclosure Statement

Two references were listed in the PTO-1449 however no copy was provided to the USPTO of these references. The Applicant hereby submits the following two references:

(a) Special Issue on Quantum Information, Physics World 11(3) 1998.

(b) Bennett CH et al. (1992), "Quantum Cryptography", Sci. Am. 267 (4): 50-57.

2. Claim Objections

The Examiner has objected to claim **45** since claim **45** depends from itself. The Examiner has assumed that claim **45** depends from claim **44**.

In reply, the Applicant confirms that claim **45** should depend from claim **44**. The Applicant has amended claim **45** to be depended from claim **44**. In addition, the Applicant has amended claim **46-47** to also be depended from claim **44**. Accordingly the Applicant kindly requests the objection related to claim **45** to be withdrawn.

3. Claim Rejections – 35 USC 112

4. The Examiner rejects claims **3**, **18**, **31-34** and **37** under 35 USC 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

4a. Claims **3**, **18** and **37** recite a "vibrational manifold". The Examiner rejects this term as not being a generic term in the art and therefore it should be defined in the respective claims.

In reply, the Applicant has canceled claims **3**, **18** and **37** and rephrased the term in their respective independent claims **1**, **16** and **35**. Accordingly the Applicant kindly requests the objection related to claims **3**, **18** and **37** to be withdrawn.

4b. The Examiner rejects claims **31-34** under 35 USC 112, second paragraph, for failing to provide the necessary structural elements to properly conform the invention. For example claims **31-34** recite optical pumping of a single molecule in a solid at room temperature. However, the claims fail to provide the necessary elements to perform such a function.

In reply, the Applicant has amended claims **31** to provide the necessary structural elements to perform such a function. Claims **32-34** have been canceled. Accordingly the Applicant kindly requests the objection related to claims **31-34** to be withdrawn.

5. Claim Rejections – 35 USC 102

6. The Examiner rejects claims **1-50** under 35 USC 102(b) as being anticipated by Ishikawa (US Patent No. 5,528,046). The Examiner rejects claims **1-6, 15-21, 30, 33-39, 48** and **49** under 35 USC 102(b) as being anticipated by Kuhn. The Examiner rejects claims **1-10, 15-17, 20-25, 30, 33-43** and **48** under 35 USC 102(b) as being anticipated by Brunel.

In reply, the Applicant argues that Ishikawa et al., Kuhn et al. and Brunel et al. either as separate teachings or as a combination of teachings do not anticipate nor suggest the claims of the present application. The Applicant provides the following arguments.

The present application teaches and claims a novel and unobvious device, method and system as a source of single photons at room temperature. The present application teaches that this is a controllable source that can deliver a single photon with a high probability. This is clearly discussed in the specification of the present application as well as in U.S Provisional Application 60/266,955 filed 02/07/2001 to which the present application is cross referenced to and claims priority from. More specifically, the provisional application incorporates the paper by Lounis and Moerner (both inventors of the present application) entitled "Single photons on demand from a single molecule at room temperature" published in NATURE 407:28 September 200, 491-493. This paper presents the probability of a single photon emission in analysis and graph format.

As taught in the present application, to control with a high probability single photon emission from a single molecule one at a time at room temperature, the following features need to be considered:

1. provide a single molecule at room temperature as a controllable source for a single photon;
2. pump the single molecule with a high energy (strong enough) light pulse to force the single molecule into a vibronically excited level of the electronic excited state which then quickly decays back to the lowest electronic excited state. As it is known in the art, the time for decay from a vibronically excited level of the electronic excited state to the lowest electronic excited state is on the order of 1 picosecond.
3. the duration of the pumped light pulse is shorter than the relaxation time of the single molecule back to the ground state.

The independent claims **1, 16, 31** and **35** have been amended to more distinctly point out and claim these features and therewith the differences with the prior art of record.

Ishikawa

Ishikawa teaches a method and device for determining the location and number of a group of fluorescent molecules by the detection of photons recorded as a quantized number of photons generated per unit period of time of the group of fluorescent molecules and by a distribution of appearance frequencies of the fluorescence photons generated per unit of time formed on a two-dimensional image. Ishikawa uses a continuous wave laser (See

Column 6, line 1-2) and irradiates for a relatively long period of time (e.g. 60 seconds). Such a long irradiation with a continuous laser does not generate a single photon at a controllable time. Furthermore, such a long irradiation would be longer than the relaxation time of the single molecule from the vibronically excited state back to the electronic ground state to emit the single photon from the single molecule. Thus the photons generated appear at random times, without any control. If it were possible that Ishikawa did place a molecule in the vibronically excited state (however Ishikawa does not mention pumping into the vibronically excited state), then photon emission would occur at random times without any control.

Ishikawa determines location and number of molecules by averaging 1000 photons over 60 seconds to obtain a photon emission rate (See FIG. 17), which is different from creating a controllable source of single photons. Since Ishikawa averages over a period of time, there is no single photon emission one at a time that can be controlled, but rather a collection of photons emitted randomly that can never be considered as a controllable source for single photons one at a time. If it were to be argued that Ishikawa has a source of single photons, then one may ask where does Ishikawa demonstrate the probability of such a single photon emission. In other words, what are the chances of Ishikawa to emit a single photon one at a time, since there is neither a chance nor a guarantee to actually be in the state that is required for single photon emission as taught in present application. Ishikawa simply continuously irradiates for determining the location and number of fluorescent molecules in a group by recording the average number of photons generated per unit period of time.

As a side note, Ishikawa states in Column 1, lines 65-67 to Column 2, lines 8:

"A third conventional method for single fluorescent molecule detection relies on high resolution spectroscopy of a single impurity aromatic molecule (pentacene) embedded in an organic molecule (paraterphenyl). This third conventional method, which is disclosed in J. Chem. Phys. 95(10), 15 Nov. 1991, 7150-7163, is not suitable for detecting the base. However, this method measures a fluorescence excitation spectrum of pentacene at ultra-low temperature (about 4K) to measure a uniformly wide spectrum in a non-uniformity wide spectrum, thereby using the former as a fluorescence spectrum of the single molecule."

The Applicant would like to point out that the referenced paper is by Prof. W. E. Moerner (an inventor of present application) and his colleagues. Ishikawa mentions that this method is not suitable for detecting the base and is hereby in fact teaching away from the teaching in the 1991 paper. Furthermore, the referenced method in the 1991 paper requires ultra low temperature of a few degrees Kelvin, which is in sharp contrast to the single molecule at room temperature in the present application.

In conclusion, the Applicant submits that independent claims **1, 16, 31** and **35** now in the application are novel and unobvious over Ishikawa and therewith also that the dependent claims now in the application and depended from independent claims **1, 16, 31** and **35** are novel and unobvious over Ishikawa. Accordingly the Applicant kindly requests the rejection related to claims **1-50** to be withdrawn.

Kuhn

Kuhn teaches a controlled generation of single photons from a strongly coupled atom-cavity system (See FIG. 1 in Kuhn). This approach requires a sophisticated adiabatic passage technique occurring in a strongly-coupled atom-cavity system (page 374, lines 6-7 in Kuhn). The present application does not use a strongly coupled atom-cavity system and does not require a sophisticated adiabatic passage technique. Kuhn's approach is much more complex and teaches away from the present application. In conclusion, Kuhn cannot anticipate nor suggest the claims in the present application.

Therefore, the Applicant submits that independent claims **1**, **16** and **35** now in the application are novel and unobvious over Kuhn and therewith also that the dependent claims now in the application and depended from independent claims **1**, **31** and **35** are novel and unobvious over Kuhn. Accordingly the Applicant kindly requests the rejection related to claims **1-6, 15-21, 30, 33-39, 48** and **49** to be withdrawn.

Brunel

Brunel teaches a triggered source of single photons that requires an adiabatic passage with an RF (radio-frequency) source of applied electric field (See FIG. 1 in Brunel and see page 2722, second column, lines 20-21 in Brunel), which has to be performed at a low temperature. The Applicant would like to point out that the referenced paper is by Dr. Brahim Lounis (an inventor of present application) and his colleagues. The present application does not require a low temperature and does not require a sophisticated

adiabatic passage technique nor a secondary source of applied RF field. Brunel's approach is much more complex and teaches away from the present application. In conclusion, Brunel cannot anticipate nor suggest the claims in the present application.

Therefore, the Applicant submits that independent claims **1, 16** and **35** now in the application are novel and unobvious over Brunel and therewith also that the dependent claims now in the application and depended from independent claims **1, 31** and **35** are novel and unobvious over Brunel. Accordingly the Applicant kindly requests the rejection related to claims **1-10, 15-17, 20-25, 30, 33-43** and **48** to be withdrawn.

IN CONCLUSION

This reply encompasses a bona fide attempt to overcome the objections and rejections raised by the Examiner and the reasons why the Applicant believes the objections and rejections should be withdrawn. The claims now in the application are novel and unobvious over the prior art of record. The present application provides a novel and unobvious controllable source of single photons that can be delivered at room temperature in an elegant and simple fashion. Accordingly, allowance of the claims now in the application is kindly requested.

Respectfully submitted,

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